

a3 [0024.01] An additional object of the invention is to provide a watercraft with a steer responsive engine speed controller that functions to increase engine speed based on steering signals regardless of manual throttle control.

a4 [0025] As embodied and broadly described herein, this invention seeks to provide a watercraft comprising a hull, and a steerable propulsion unit driven by an internal combustion engine that is capable of generating thrust and capable of steering the watercraft by directing the thrust in a desired direction. A manual throttle control is provided to control the speed of the internal combustion engine, and a manual steering control is provided for steering the watercraft. An actuator responsive to the manual steering control causes the steerable propulsion unit to generate a propulsive force at least equal to the minimum propulsive force necessary to effectively steer the watercraft when the manual steering control is turned in either direction beyond a predetermined angular threshold, whereby the watercraft can remain maneuverable independently of the manual throttle control setting.

[0026] When the manual steering control is turned beyond a certain, predetermined angular threshold, the actuator opens the throttle such that the propulsive force generated by the steerable propulsion unit is increased to a level corresponding to the minimal propulsive force needed to effectively steer the watercraft. This augmentation of propulsive force only occurs if the manual throttle control is set to produce a propulsive force less than the minimal propulsive force required for effectively steering the watercraft. Otherwise, if the manual throttle control is set to produce a thrust exceeding the minimal propulsive force required to effectively steer the watercraft, the throttle will remain open at the level set by the manual throttle control. Of course, if the manual throttle control is then reduced to below the threshold setting, the actuator causes the throttle to remain open so as to produce the minimal propulsive force necessary to effectively steer the watercraft. Thus, whenever the manual steering control is turned beyond the angular threshold, the actuator automatically ensures that the steerable propulsion unit generates the minimal propulsive force necessary for effectively steering the watercraft. Thus, the watercraft is maneuvered more easily since a turning thrust is automatically generated.

[0027] It is another object of the present invention to provide a watercraft with a steer-responsive engine assembly controlled by an electronic control system.

[0028] As embodied and broadly described herein, the present invention seeks to provide a watercraft comprising a hull, and a steerable propulsion unit driven by an internal combustion engine that is capable of generating thrust and capable of steering the watercraft by directing

the thrust in a desired direction. A manual throttle control is provided for controlling the speed of the internal combustion engine, and a manual steering control is provided for steering the watercraft. An actuator is provided that is responsive to a signal for causing the steerable propulsion unit to generate a propulsive force at least equal to the minimum propulsive force necessary to effectively steer the watercraft for a given speed when the manual steering control is turned in either direction beyond a predetermined angular threshold, which causes the watercraft to remain maneuverable independently of the manual throttle control setting. The system also includes a steer angle measuring device for generating a steer angle signal representative of the steer angle of the steerable propulsion unit, a speed measuring device for generating a speed signal representative of the speed of the watercraft, and an actuator control circuit for generating an output signal for controlling the actuator. The actuator control circuit has a first input for receiving the steer angle signal, a second input for receiving the speed signal, and an output signal generator for generating an output signal in response to signals received at the first and second inputs. The output signal is applied to the actuator for controlling the actuator.

[0029] This steer-responsive engine assembly further incorporates an electronic control system that senses the steer angle of the manual steering control as well as the speed of the watercraft and then computes a setting that corresponds to a propulsive force appropriate for steering the watercraft.

[0045] Figure 14 is a schematic depicting a second embodiment of the steer-responsive system in accordance with the present invention, the engine speed being controlled by a control system; and

[0051] Referring back to Figure 1, the steering angle of the steering nozzle 14 is controlled by a manual steering control such as a steering wheel 16 which actuates the steering nozzle 14 via a steering assembly 18 and a steering nozzle cable 19. In the case of a personal watercraft, the manual steering control would be a pair of handlebars. In the case of a motorboat, the manual steering control would be either a steering wheel or tiller. In any case, even the electronically controlled embodiments described below, turning the steering element causes a responsive steering movement to the propulsion device. In other words, turning the steering element generates a steering signal, which could be a mechanical, electronic or some other suitable signal.